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IMAGES IN INTERVENTION

Percutaneous Pulmonary Valve Implantation in a Native Outflow Tract

3-Dimensional DynaCT Rotational Angiographic Reconstruction and 3-Dimensional Printed Model

Joseph T. Poterucha, DO,* Thomas A. Foley, MD,† Nathaniel W. Taggart, MD*

A 15-year-old girl with D-transposition of the great arteries presented with combined neo-pulmonary stenosis and regurgitation following arterial switch operation as a neonate and neo-pulmonary valvectomy at 6 years of age. Echocardiography revealed right ventricular enlargement and severe neo-pulmonary regurgitation and stenosis with a mean Doppler gradient of 47 mm Hg. Right ventricular end-diastolic volume by cardiac magnetic resonance was 201 ml/m^2. She underwent cardiac catheterization with 3-dimensional (3D) DynaCT rotational angiography and 3D reconstruction (Siemens, Munich, Germany) (**Figure 1A**, Online Videos 1 and 2). Catheterization demonstrated a peak-to-peak pulmonary gradient of 38 mm Hg. The right ventricular outflow tract (RVOT) measured 16 mm angiographically. Sequential placement of a 26-mm ev3 IntraStent LD Max (ev3-Endovascular, Plymouth, Minnesota)

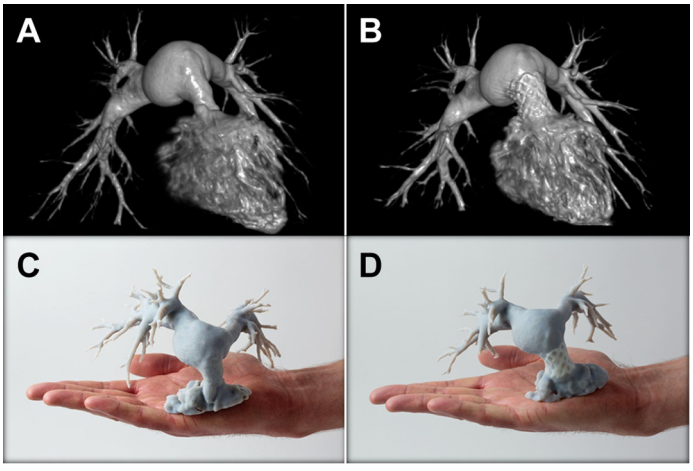

FIGURE 1 3D Reconstruction and Printed Model Pre- and Post-PPVI

Pre- **(A, C; Online Videos 1 and 2)** and post- **(B, D; Online Videos 3 and 4)** Melody valve implantation 3D DynaCT reconstruction and printed model. 3D = 3-dimensional; PPVI = percutaneous pulmonary valve implant.

From the *Division of Pediatric Cardiology, Mayo Clinic College of Medicine, Rochester, Minnesota; and the †Department of Radiology, Mayo Clinic College of Medicine, Rochester, Minnesota. The authors have reported that they have no relationships relevant to the paper to disclose.

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and a Palmaz-XL-3110 stent (Cordis, Johnson & Johnson, Bridgewater Township, New Jersey), both delivered over a 22-mm × 4-cm Z-med balloon (PFM Medical, Cologne, Germany) established a satisfactory landing zone for percutaneous pulmonary valve implantation. A Medtronic Melody valve (Medtronic, Fridley, Minnesota) was successfully placed in the RVOT using a 22-F Ensemble delivery system (Medtronic), resulting in resolution of neo-pulmonary regurgitation and improvement in peak-to-peak gradient to 15 mm Hg. DynaCT rotational angiography and reconstruction was again performed (**Figure 1B**, Online Videos 3 and 4). The 3D rotational angiogram DICOM (Digital Imaging and Communications in Medicine) data was then processed offline using dedicated software (Materialize, Leuven, Belgium) to create STL (stereolithography) files for 3D printing. Life-size 3D printing was performed using an Objet Connex350 3D Printer (Stratasys Ltd., Eden Prairie, Minnesota) (**Figures 1C and 1D**).

Off-label percutaneous pulmonary valve implantation has been safely demonstrated in patients with unfavorable anatomy including patients with conduit-free RVOT, native pulmonary valves, and small conduits. Creation of an adequate landing zone with pre-stenting of the RVOT is critical to successful placement (1). This is the first reported case of percutaneous pulmonary valve implantation into a native RVOT using 3D rotational angiography for guidance of stent and valve implantation. Three-dimensional printed models provide a novel and valuable tool for patient and trainee education.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. Joseph Poterucha, Division of Pediatric Cardiology, Department of Pediatric and Adolescent Medicine, Mayo Clinic College of Medicine, 200 First Street SW, Rochester, Minnesota 55905. E-mail: poterucha.joseph@mayo.edu.

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APPENDIX For accompanying videos, please see the online version of this article.